Crane Calculation Template

Example 1 Ground Pressure Known (Find Area of Pad Size)

Outrigger Pont Loading (Based on 25tGround Bearing Pressure)

$$\frac{\text{Weight of crane + weight of load}}{\text{Ground Bearing Pressure}}$$

Weight of Crane	72t
Weight of Counterweight	60t
	132t

Weight of Load	11.4t
Hook Block / Tackle	0.7t
Fly Jib (If Fitted)	0.5t

132 x 0.75 (Point load) + 11.4 + 0.7 + 0.5 = 111.6

111.6 / 25 (GBP) =4.464m²

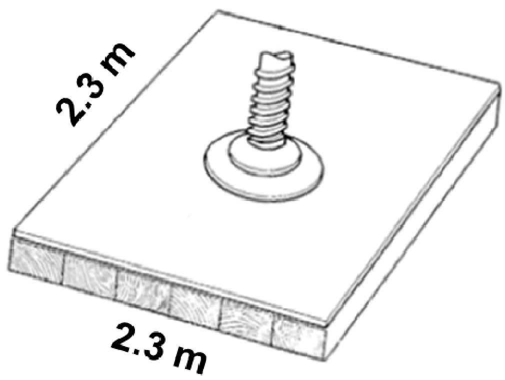
√4.464 = 2.1128

Pad Size 2.1

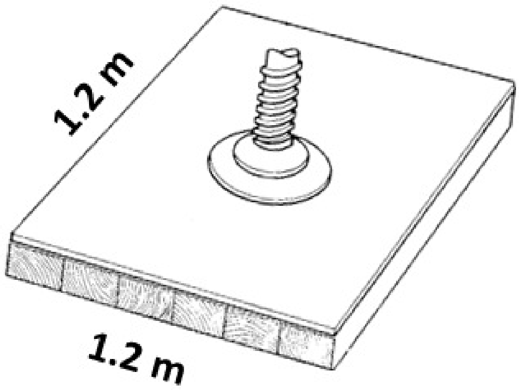
Round Pad Size Up to 2.3

2.3 x 2.3 = 5.29m² (111.6 / 5.29 = 21.0t)

Outrigger Point Load = 21t



Example 2 Calculate from Pad Size



$1.2 \times 1.2 = 1.44m^2$

$$\frac{\text{Weight of crane + weight of load}}{\text{Area of Pad}}$$

Weight of crane: 50 Tonne
Weight of load: 22 Tonne
(Including Block / Tackle

Area of Outrigger Pad 1.44 m^2

72 tonnes ÷ 1.44 X 75% X 10 (Converts into KiloNewtons)

= 37,500kN

Example 3 Ground Bearing Pressures Tables

1. **Crane Weight**
   The maximum weight of the crane to be used 50,000kgs (worst case scenario)

2. **Load**
   The maximum load to be lifted 22,000kgs + Load 1,500kgs

3. **Outrigger Load**
   Point load = (1+2) x 100% = (50,000 + 23,500) x1 = 73,500kgs or 73.5t

4. **Ground Type**
   Ground comes in granular and cohesive types.

Bearing Values BS: 8004

Non-Cohesive Soils		
Dense Gravel or Dense Sand and Gravel	>61.2 t/m²	>600 kN/m²
Medium Dense Gravel, or Medium Dense Sand and Gravel	20.4—61.2 t/m²	200—600 kN/m²
Loose Gravel, or Loose Sand and Gravel	<20.4 t/m²	<200kN/m²
Compact Sand	>30.6 t/m²	>300 kN/m²
Medium Dense Sand	10.2—30.6 t/m²	100—300 kN/m²
Loose Sand *	10.2 t/m²	<100 kN/m²
* (Depends on degree of looseness)		

Cohesive Soils		
Very Stiff Boulder Clays and Hard Clays	>61.2 t/m²	300—600 kN/m²
Stiff Clays	15.3—30.6 t/m²	150—300 kN/m²
Firm Clay	7.6—15.3 t/m²	75—150kN/m²
Soft Clays and Silts	<7.6 t/m²	<75 kN/m²
Very Soft Clay	Not Applicable	Not Applicable
Peat	Not Applicable	Not Applicable

5. **Mat size**

   Mat size deducted from point load in 3 (in kNs) / (Soil type value 2)
   73500 x 9.81 = 721,035 kNs
   721.0kNs / 300KN/m^2 = 2.40 m^2
   = 1.6m X 1.6m minimum

   A. Soil is compact ground (gravel 100mm in depth) covered in tar. Two outriggers will be placed here. The other two will be placed on medium dense gravel [Dense gravel has a bearing value of >600kNm^2 medium dense gravel <200 – 600kNm^2] Area has transport trailers carrying ISO containers so a pessimistic ground bearing value of 300kNm has been selected.

Example 4 Outrigger Loading Template

Mat Area Calculation Template

Stage 1: Gross Load Calculation

Net Load		t
Lifting at height: Load x 1.2 (SF) t		t
+ Accessories		t
Hook Block		t
+ Stored Fly Jib		t
Gross Load =		t

Stage 2: Crane Selection Template

Crane Selected and Capacity:					
Counterweight / Ballast Used					t
Boom Length Required					m
Length & Angle if Fly Jib Used				m	deg
Maximum Radius From Load Chart			m		SWL
Minimum Radius Required					m
SWL at Radius Used					t
Outrigger Spread		mm			mm

Stage 3: Crane Utilization

Gross Load X 100 Divided by SWL @ the Radius Worked:			
Workings		Crane Utilization	%

Stage 4: Crane Matt Calculation

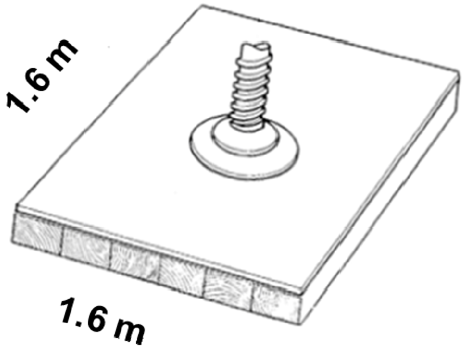
12t Per Axle			
Weight of Crane			t
Counterweight / Ballast			t
=			
X0.75% (Point Loading)			t
+ Gross Load			t
Total			t
÷ by Ground Bearing Allowance	25		kNs
Area of Mat Equals =			m²
√		x	m
Total all up Weight Dived by the Area of Mat Used			
Point Load			t

Stage 5: Bearing Pressure

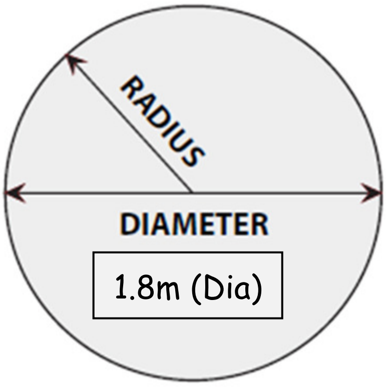
Actual Bearing Pressure Under Mat (Maximum Point Load)			
New Mat Size Area (Length x Breadth)			
Total all up Weight Dived by the Area of Mat Used			m²
Or m Diameter if Circular			
	Resulting Loading		kNs

Converting Square to Round Pads

1.6 X 1.6 = 2.56m



2.56 ÷3.14 = 0.815
√ 0.815 = .903 (Radius)
X 2 = 1.8m (Dia)



Crane Utilisation: Load X 100 ÷ Radius

12 t	3.5 m*			360°		9.8 m/s		EN 13000
	10,3 m	14,0 m	17,7 m	21,3 m	25,0 m	28,7 m	32,4 m	
m								m
3	41,90	-	-	-	-	-	-	3
3,5	37,45	-	-	-	-	-	-	3,5
4	30,70	29,05	27,50	-	-	-	-	4
4,5	25,95	24,60	23,55	-	-	-	-	4,5
5	22,35	21,20	20,35	20,00	14,50	-	-	5
6	17,20	18,60	15,70	15,85	13,30	9,60	-	6
7	13,85	14,05	12,55	12,85	12,80	8,50	6,00	7
8	11,30	11,70	10,15	10,55	1065	8,00	5,70	8
9	-	9,90	9,00	8,85	9,05	7,50	[illegible]	9
10	-	8,45	8,20	7,40	7,70	7,00	5,00	10
11	-	7,30	7,50	6,35	6,65	6,65	4,70	11
12	-	6,45	6,45	5,50	5,70	5,85	4,50	12
13	-	-	5,70	4,75	5,05	[illegible]	[illegible]	13
14	-	-	5,15	4,30	4,30	4,50	4,00	14

Crane Configuration – Radius: 12m – Boom length: 32.4m (Crane can lift 4.5 tons)

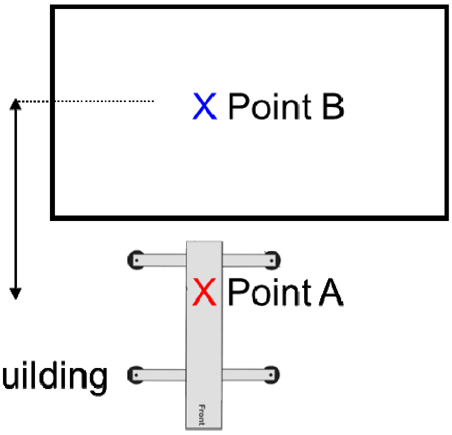
Crane Utilisation

Load 4t x 100 ÷ 4.5 = 88.8% Crane Utilization too high for hazardous area (Chemical Plant)

You would need to Reduce Boom Length or Reduce Crane Radius

Load 4t (@10m) x 100 ÷ 5t = 80.0% Crane Utilization Good

RADIUS: Straight Line Lifts



All Operators must fully understand Where & How to position their crane safely

To many accidents are caused by the operator not positioning the crane correctly

Lift: You have to position a load centred on the roof of a building

The easiest lift you can do is a straight line lift (from point A to point B)

Stage 1: Position crane (centre of slew ring) on the X directly in front of the drop point X B Note: Do not position the crane to close or to far away from building (Safe distance)

Step 2: Find centre point of building and pace distance back to centre of slew ring (in metres)

Step 3: You can now check cranes load charts to see if you can lift the load at that radius

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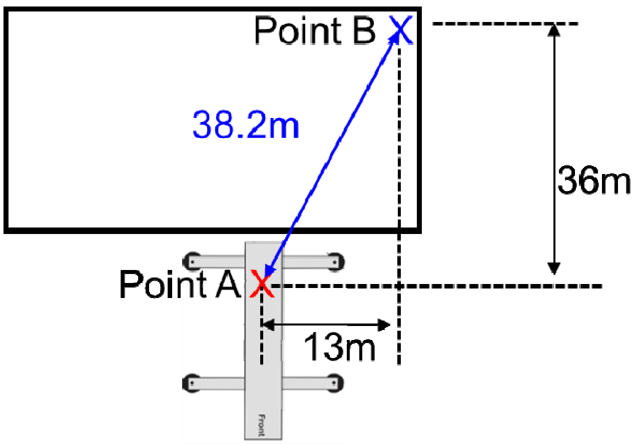
RADIUS: Angled Lifts



Angled lifts need more planning

Lift: You have to position a load on the corner of a building

No lifting within shaded area

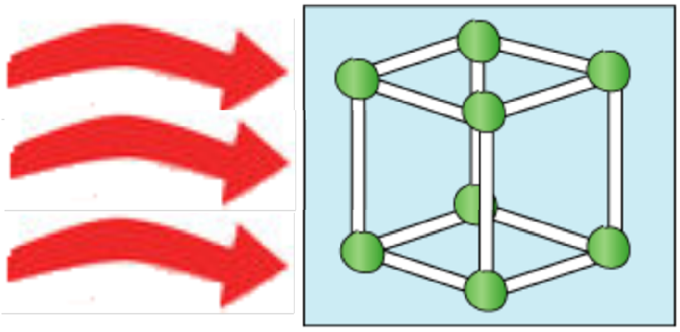
Stage 1: We need to measure from B to A X then from A X to X B

Step 2: We now have 2 known distances 36 and 13

Step 3: If we times 36 x 36 = 1296 and times 13 x 13 = 169. Add both numbers together 1296 + 169 = 1465 and square root √1465 = 38.2

Radius from point A – B is 38.2 metres

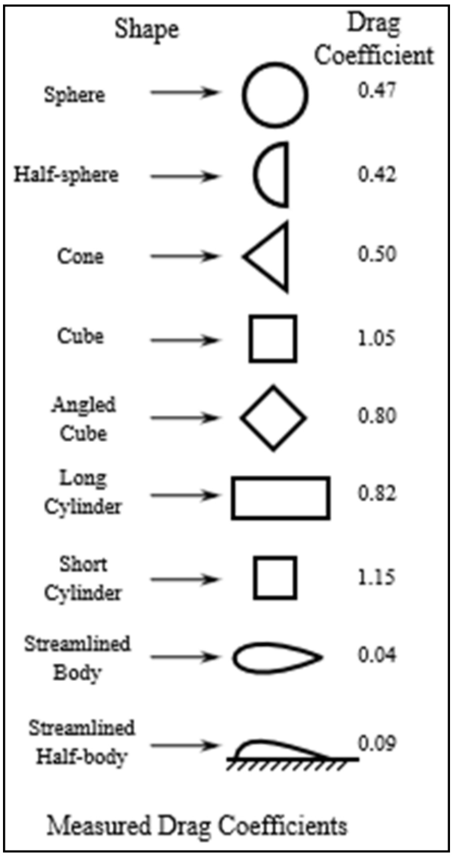
Wind Resistance Coefficient (See BS7121 Page 78)



Wind Pressure on Load

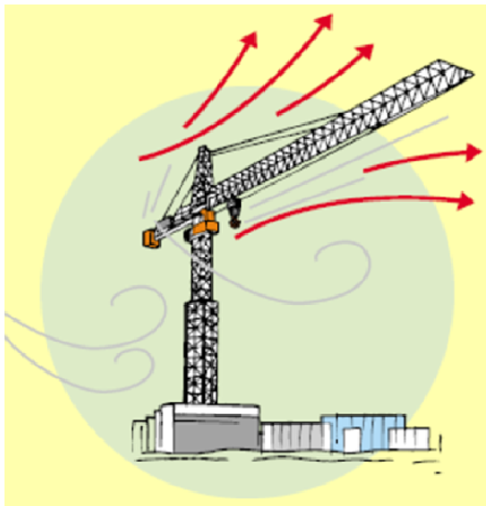
1	92 -	0 +	0 +	0 +	0 +	0 +	0 +	0 -	46 -	92 -
2	46 +	0 +	0 +	0 +	0 +	0 -	46 -	46 +	46 +	46 +
3	46 +	0 +	0 +	0 -	46 -	46 +	46 +	46 +	46 +	46 +
4	0 +	0 -	46 -	46 +	46 +	46 +	46 +	46 +	46 +	46 +
5	0 +	0 +	0 +	0 +	0 +	0 +	0 +	0 +	0 +	0 +
%										
m/s	11,1	14,3	14,3	14,3	12,8	12,8	12,8	12,8	11,1	11,1

Check Wind Speed on Load Charts
(Most Cranes have a Maximum Wind Speed of 9.8 M/P/S)



Example Only

Mobile cranes are designed with a standard drag factor of 1.2 and a wind area/weight of 1.2 m^2/tonne.

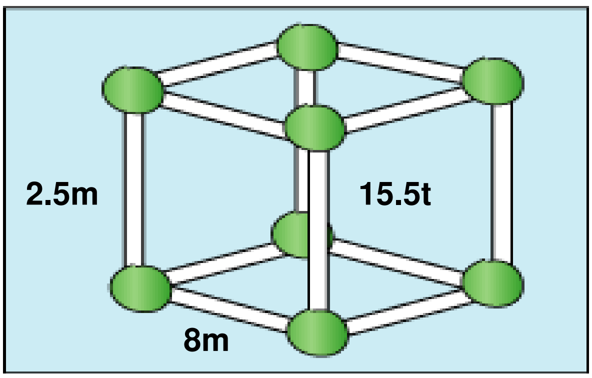


This means that certain types of loads will produce higher side loads on the crane than it is designed to take

Load	*Drag Factor c_w*
Standard values from EN13000	1.2
12m Container Cabin	1.55
System Shutter Panel 3m high x 1.9m wide	1.4
Wind Turbine Rotor	1.5 to 1.8

Sail Area of Load

2.5 X 8 = 20m^2 (Sail Area)



Wind Resistance Coefficient

$$V^{Max} = V^{Chart} \times \sqrt{\frac{1.2 \times M}{A^p \times C^w}}$$

V^{Max} = Maximum Permitted Wind Speed (For New Load)

V^{Chart} = Maximum Wind Speed of Crane (Boom Configuration)

1.2 = Manufacture Test Standards (EN 13000 - 2010 / ISO 4306-2:2012)

M = Maximum Gross Weight

A^p = Sail Area of Load

C^w = Resistance Coefficient (1.4) (Example)

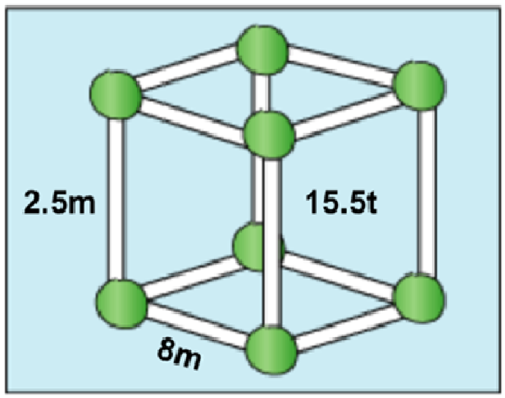
1.2 x 15.5 = 18.6
(Manufacture Test Standards) X (Load Weight)

20 x 1.4 = 28 (wind load Area)

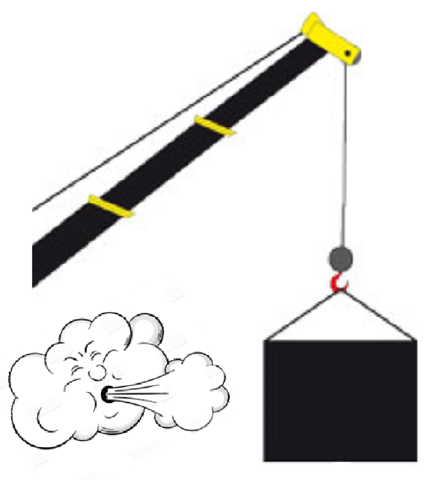
18.6 ÷ 28 = 0.6643

$\sqrt{0.6643} = 0.81504$

0.81504 x 12.8 = 10.43

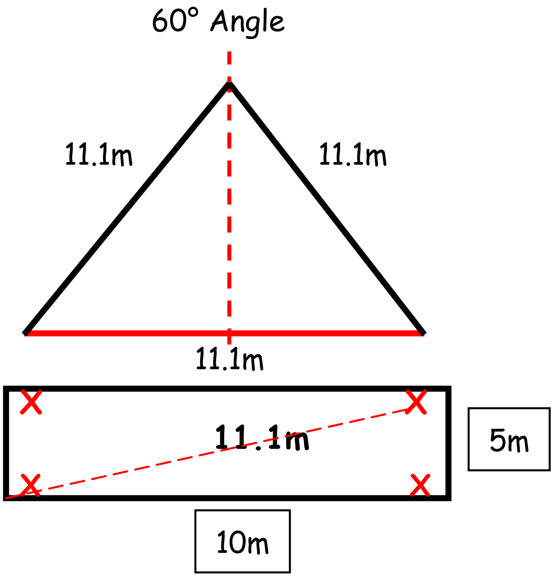


2.5 X 8 = 20m²

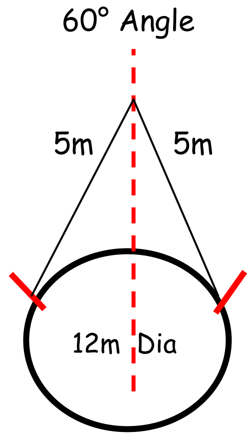


10.43 m/s (Maximum wind speed)

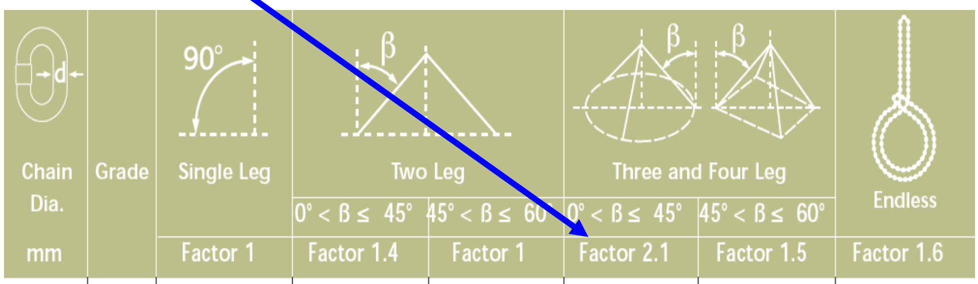
Slinging: 4 Leg   2 Leg



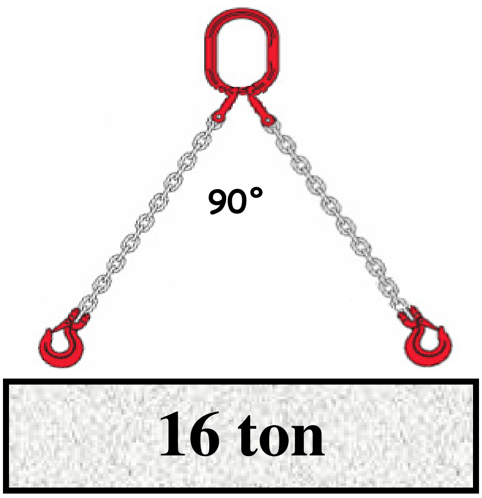
5 x 5 = 25
10 x 10 = 100
125   √125 = 11.1m slings to be used.
Multiply 2.1 to Load weight to get SWL of sling



12 x 75% = 9
9 x 3.14 = 28.26m
28.26 + 10 = 38.26m
Multiply 1.4 to load weight for SWL of sling



Chain Dia. mm	Grade	Single Leg 90°	Two Leg		Three and Four Leg		Endless
			0° < ß ≤ 45°	45° < ß ≤ 60°	0° < ß ≤ 45°	45° < ß ≤ 60°	
		Factor 1	Factor 1.4	Factor 1	Factor 2.1	Factor 1.5	Factor 1.6



X Mode Factor to Load

Magic Sevens
1 x 7 = 7
2 x 7 = 1.4
3 x 7 = 2.1
(4 Legs same as 3 legs)

To calculate what SWL is needed for slings
Multiply 1.4 to load weight 16t
1.4 x 16 = 22.4 tonne slings for lift